APPENDIX C
ESTIMATING MOVEMENTS AND SHIPMENTS

Shipment Configurations and Modal Discussion. Appendix Figure C2 provides additional information on the matter of estimating *shipments* versus *movements*, a subject briefly discussed in both Sections 2 and 3. Appendix Figure C1 is the same as text Figure 1, and it is replicated herein to facilitate the further discussion.

That a single shipment might entail multiple vehicle, vehicle-rail car, or vehicle-aircraft movements is readily illustrated by examples such as Schematic #2 or Schematic #4. Where generating an estimate of movements grows more complicated is with situations involving shipment consolidation, such as situations illustrated by Schematics #9-12.

It was discussed in Section 2 (p. 4) that small package and LTL truck operations typically consolidate multiple shipments in a single vehicle. The same is true for air freight operations, especially small package air freight, wherein multiple shipments will be transported in a single vehicle or aircraft along one or more legs of the total delivery route. For both surface and air operations, these consolidated shipments could involve many combinations of a single or multiple origin points and a single or multiple destination points. The schematics in Appendix Figure C2 illustrate just some of the possible configurations involving multi-origin and multi-destination shipments. Schematic # 9, in addition to depicting an LTL operation, specifically illustrates consolidation of air package shipments.

In terms of estimating the number movements associated with a given number of shipments, each of the Schematics #9-12 helps illustrate the difference between movements of given shipments and movements of the vehicle (or aircraft, etc.) associated with those shipments. In schematic #10, for example, each of the 5 originating shipments is moved twice, suggesting 5x2 or a total of 10 movements. Yet, there are only 5 + 1 **vehicle movements** involved. Consequently, as indicated earlier, this report would tally Schematic #10 as 5 shipments but 6 movements. The same is true for Schematics #11 and #12. In each of these three later situations, the number of movements is just a little higher than 1.0 times the number of shipments, i.e., a factor of 1.2 times the number of shipments.

In Schematic #9, if the 5 originating shipments travel by LTL truck, there are 5+1+5 = 11 vehicle *movements*. If the 5 shipments travel by air, there are 5+1+1+1+1+5 = 14 vehicle and aircraft *movements* associated with the 5 shipments. These two respective movement factors are 2.2 and 2.8 times the number of shipments. Thus, for Schematics #10-12, the movement factor is close to 1 times the number of shipments; for both the trucking and air components of Schematic #9, the movement factor is over 2.0 and approaches 3.0 times the shipment number. Without access to detailed analysis of which consolidated-operation configurations pervade the freight moving industry, we have assumed an average *movement* factor for LTL, ground package, and air cargo operations of 2.0. These factors were applied to the shipment numbers in Table 2 and helped produce the summary figures in Table 1 (*movements* and *tons moved*).

For estimates of the number of movements in the rail, water, and pipeline sectors, *movement* factors of 3.0, 2.0, and 1.0 times the respective number of shipments have been assumed. For the rail sector, a factor of 3.0

has been used to reflect the frequency with which rail cars may be reconfigured within a train or switched from one train to another, usually after passing through a rail switching yard or so-called "humping" operations. There are certainly situations where one or more rail hazmat cars will travel essentially directly and unimpeded from origin to destination. It is assumed herein that such traffic is the exception, however, and without access to more detailed operational analyses, we have assumed an average movement factor of 3.0 times the number of shipments.

For water mode movements, a factor of 2.0 has been used. That number is assumed to be reasonable, but as to how closely it reflects actual water operations would require research and evaluation beyond the scope of this analysis. One might argue, for example, that passage of a barge through a lock on the inland waterway system is effectively equivalent to the transfer of a truck trailer or container to the rail mode. And, given that typical water shipments entail navigation of multiple locks, a much higher movement factor might therefore be warranted. Similarly, many water mode shipments involve a rail or truck distribution segment at either the origin, destination, or both ends of the water trip. Still, large amounts of waterborne commerce go almost directly from one port to another and are off loaded into the pipeline system. If such traffic is also separately captured by the pipeline mode, the shipment configuration for water would imply one *movemen*t for each one *shipment*. Given these uncertainties, a factor of 2.0 has been assumed and is considered reasonable.

For pipeline, discussions with the industry indicated that even the term "shipment" is not conventional within the pipeline sector, let alone the fact that shipment estimates are generally unavailable. Rather, industry and government officials tend to speak in terms of tons or ton-miles moved. To keep calculations, as well as the concepts, of pipeline *shipments* and *movements* relatively simple, we have assumed that movements are equal to the number of shipments.

Product Categories and Movement Factors. In addition to the differences in movement factors that apply to the modes, as discussed above, movement factors in this report also differ among broad product categories. For **petroleum product** distribution, for example, virtually all shipments are made by truck and entail full truckload movements from one proprietor group to another -- or to the end consumer. Truck vehicle sizes and therefore shipment sizes might differ, but truck shipments that exclude milk runs are the equivalent of movements, and vice versa. Thus, the movement-to-shipment factor is 1.0. Similarly, "milk runs" of home heating oil define *deliveries* as *shipments* and, implicitly, as *movements*.[1]

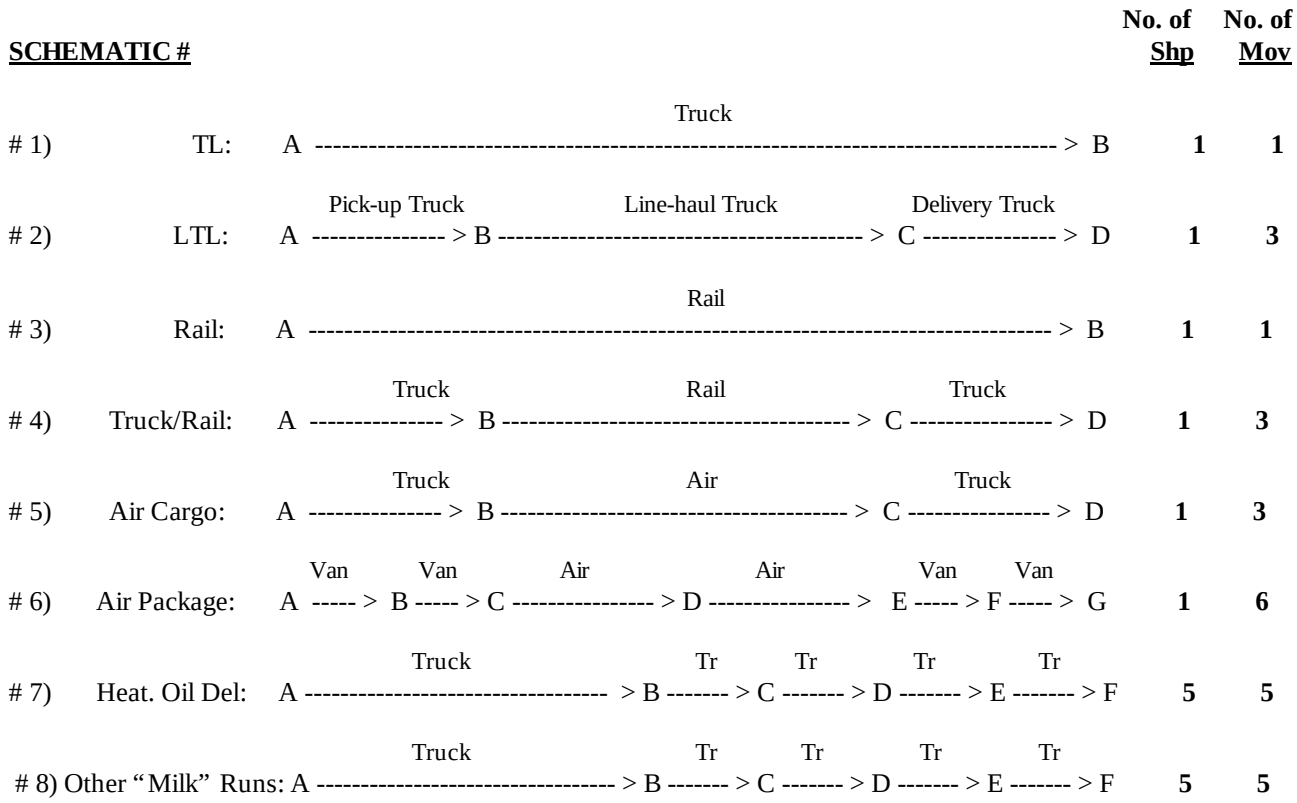
[1] There are some rail and water mode movements of petroleum products, and these (assumed) different movement factors are reflected in Table 2 and Table 1 petroleum product estimates.

For **chemical & allied product** shipments, in contrast, nearly all shipments move by truck in amounts that imply LTL or small package operations, or move by air mode. It is true that the Commodity Flow Survey (CFS) questionnaire appears worded to identify most separate movements as actual shipments -- implying a movement-to-shipment factor of 1.0. However, for intermodal shipments, shippers merely indicate *intermodal* without regard to a tally of individual modes actually deployed for the complete shipment. And, in as much as most LTL and air cargo deliveries are handled by for-hire carriers, it seems that most shippers would indicate a single mode, with the matter of consolidation, redistribution, and other individual vehicle (or aircraft) movements being the unrecorded business of the carriers themselves. In other words, a shipper's private carriage movements from one company facility to another may be identified as separate shipments -- and therefore equal in number to movements -- but for shipments hauled by for-hire carriers, it seems unlikely that movements from one sorting facility to another would be accounted for by any surveyed shipper. Thus, for the Chemical & Allied Products group (SIC 28) which rely on the CFS data, nearly all shipments are assumed in this report to entail multiple movements.

For discussion and analysis purposes, the CFS questionnaire instructions presented on page 4 of the report are repeated below:

> A "shipment" (or "delivery") is an individual movement of commodities **from** your establishment **to** one customer OR **to** another location of your company (including a warehouse, distribution center, retail or wholesale outlet). A shipment uses one or more modes of transportation, including parcel delivery, U.S. Postal Service, courier, private truck, for-hire truck, rail, water, pipeline, air, and other modes. Please note that for this survey:
>
> 'A full or partial truckload can be considered **one** shipment **only** if all the commodities are destined for one buyer/receiver at one location. If the truck makes multiple deliveries on a route, **each stop is considered (at least) one shipment.**'" (*emphasis in the original*)

Appendix Figure C1: SHIPMENT and MOVEMENT SCHEMATICS *

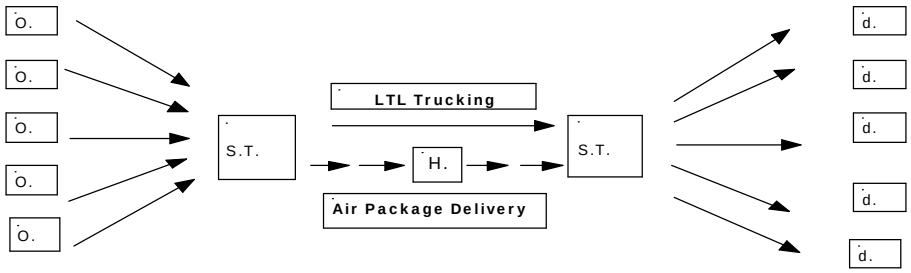


* This figure is identical to Figure 1 in the text of the report and is reshown here to facilitate the Appendix C discussion.

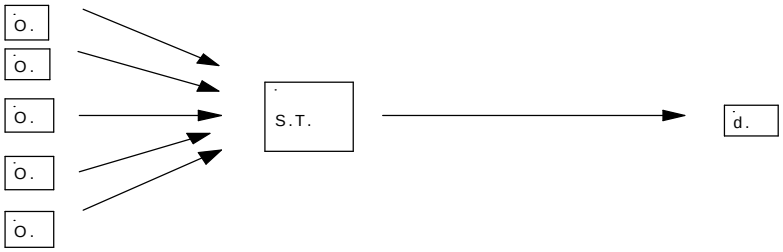
NOTES: Shp = shipments Mov = movements Tr = truck.

Appendix Figure C2: CONSOLIDATED SHIPMENT SCHEMATICS

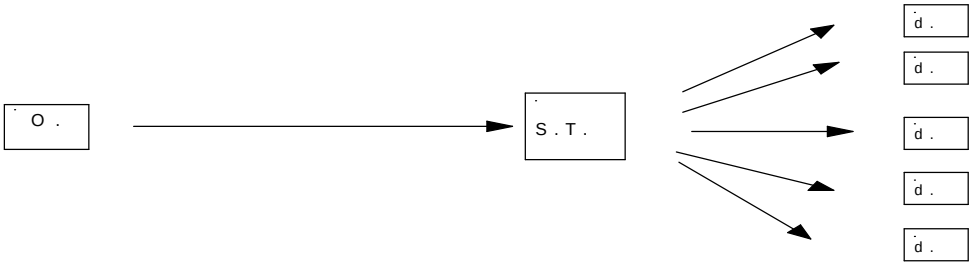
Schematic #9: Multi-origins, Multi-destinations, e.g., LTL Trucking or Air Package Delivery



Schematic #10: Multi-origins, Single Destination

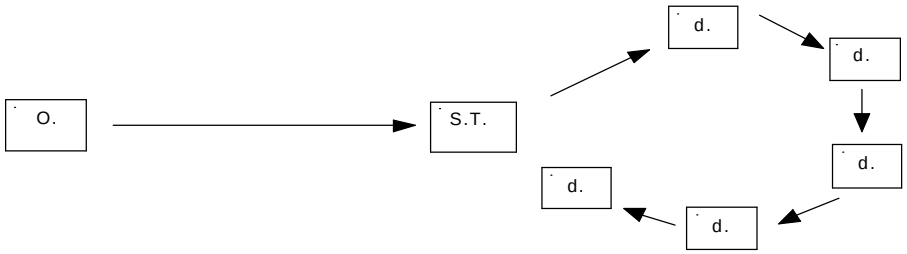


Schematic #11: Single Origin, Mutli-destinations by Multiple Delivery Vehicles



Schematic #12: Single Origin, Multi-destinations by One Delivery Vehicle

(Note similarity to Schematics #7 and #8)



O = Origin Point
ST = Sort Terminal
H = Air Cargo Hub
d = Destination (customer delivery point)